Transitioning an ACTD to an Acquisition Program

Lessons Learned from Global Hawk

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Earlier this year, the Air Force deployed two production Global Hawk aircraft in support of the global war on terror. These air vehicles replaced Advanced Concept Technology Demonstration (ACTD) prototype aircraft that had deployed three different times to Southwest Asia in the last five years. Production Global Hawks and associated support elements were available to support today's urgent global war on terror needs, less than five years after the start of the acquisition program, because the Department of Defense made the decision in 2001 to transition the program directly from the ACTD phase into simultaneous development and production. The positive reports on the performance and contribution of the production hardware validate the decision to rapidly transition the program into production. In executing this nontraditional acquisition model, we've learned a number of lessons that should be applied to future programs following a similar path.

U.S. Air Force photograph.

Early Days of the Global Hawk Program

The Defense Advanced Research Projects Agency (DARPA) initiated the Global Hawk ACTD program in 1995. The objective was to rapidly develop a high-altitude, long-endurance unmanned aerial vehicle system capable of providing broad-area surveillance. The contractor team, led by Teledyne Ryan, developed the concept of a Global Hawk system consisting of three primary hardware elements: the Global Hawk air vehicle, the mission control element, and the launch and recovery element. The system architecture provided for command and control and transmission of surveillance information via a line-of-site data link or a satellite communication link. After a successful first flight in 1998, DARPA transferred program management responsibility to the Air Force. Over the next two years, the Air Force employed Global Hawk in a series of exercises, demonstrations, and deployments, culminating in a military utility assessment (MUA) report that recommended expeditious fielding of an operationalized version of the ACTD hardware. This resulted in DoD's establishing an acquisition category (ACAT) ID program and approving the simultaneous start of engineering and manufacturing development (EMD) and low rate initial production (LRIP) in March 2001.

In November 2001, the Air Force deployed Global Hawk ACTD hardware to Southwest Asia to meet an urgent Cen-

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tral Command request for persistent, broad-area reconnaissance and surveillance for Operation Enduring Freedom. The system deployed two subsequent times over the next four years and received rave reviews for its role in CENTCOM operations. Global Hawk proved especially effective during the Iraq invasion (see imagery on page 11). With just one air vehicle deployed, the system was credited with identifying 38 percent of Iraq's armor and 55 percent of the time-sensitive air defense targets using electro-optical (EO), infrared (IR), and synthetic aperture radar (SAR) images to target Iraqi forces. These early combat deployments demonstrated the effectiveness of carrying multiple sensor capabilities on the same platform.

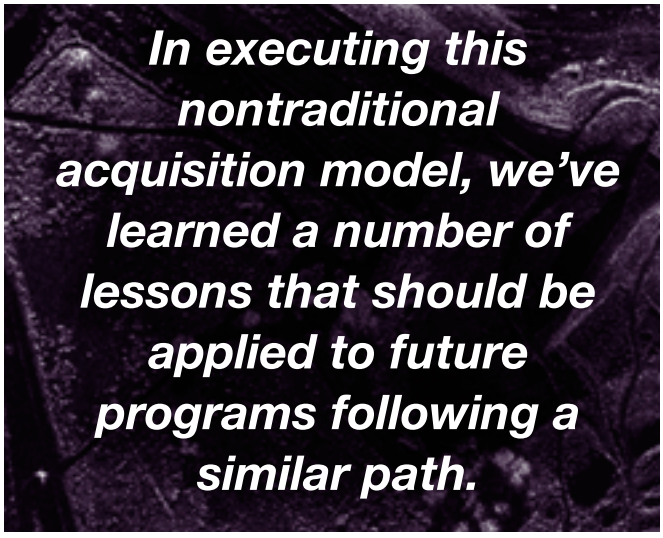
When the production air vehicles deployed earlier this year, the ACTD hardware had accumulated more than 5,000 hours of combat time and had built a reputation for effectively meeting unique global war on terror challenges. The capability of the air vehicle to fly unrefueled for more than 30 hours allowed it to remain airborne for extended periods and eliminate sanctuary for terrorists attempting to rapidly blend in with the local population. The ability of the system to operate at 65,000 feet along with its long-range sensors allowed a single air vehicle to provide surveillance over a wide area. These system attributes convinced leadership to divert the first production hardware from a training unit to replace the ACTD hardware that was approaching the end of its useful life. The production hardware has already accumulated more than 1,000 hours of successful combat time.

Lessons Learned

While supporting three combat deployments with ACTD hardware, we have now accumulated more than five years' experience executing the formal acquisition program. The nontraditional acquisition strategy that resulted from transitioning an ACTD into combined EMD/LRIP has created several challenges for the government/contractor team. Our hope is that future programs will benefit from what we've learned the hard way.

Revise Operational Test Approach and Definitions

Current Title 10 requirements and guidelines don't align well with the Global Hawk acquisition strategy. Traditional guidelines call for remaining in an LRIP status and recommend limiting quantities to 10 percent of the planned production buy until completion of initial operational test and evaluation (IOT&E). This approach works reasonably well for a sequential acquisition strategy, but becomes problematic when EMD and LRIP run simultaneously. With Global Hawk, this dilemma is further aggravated by the relatively small production run. In the first two production lots, the Air Force committed to six air vehicles, already exceeding 10 percent of the planned buy of 54. The current program plan projects an IOT&E event in 2008 – 2009 when the Air Force will have already committed to more than 50 percent of production. The critical path elements driving the IOT&E schedule are not production hardware deliveries, but the process of putting in place the support elements intended for long-term system operation.

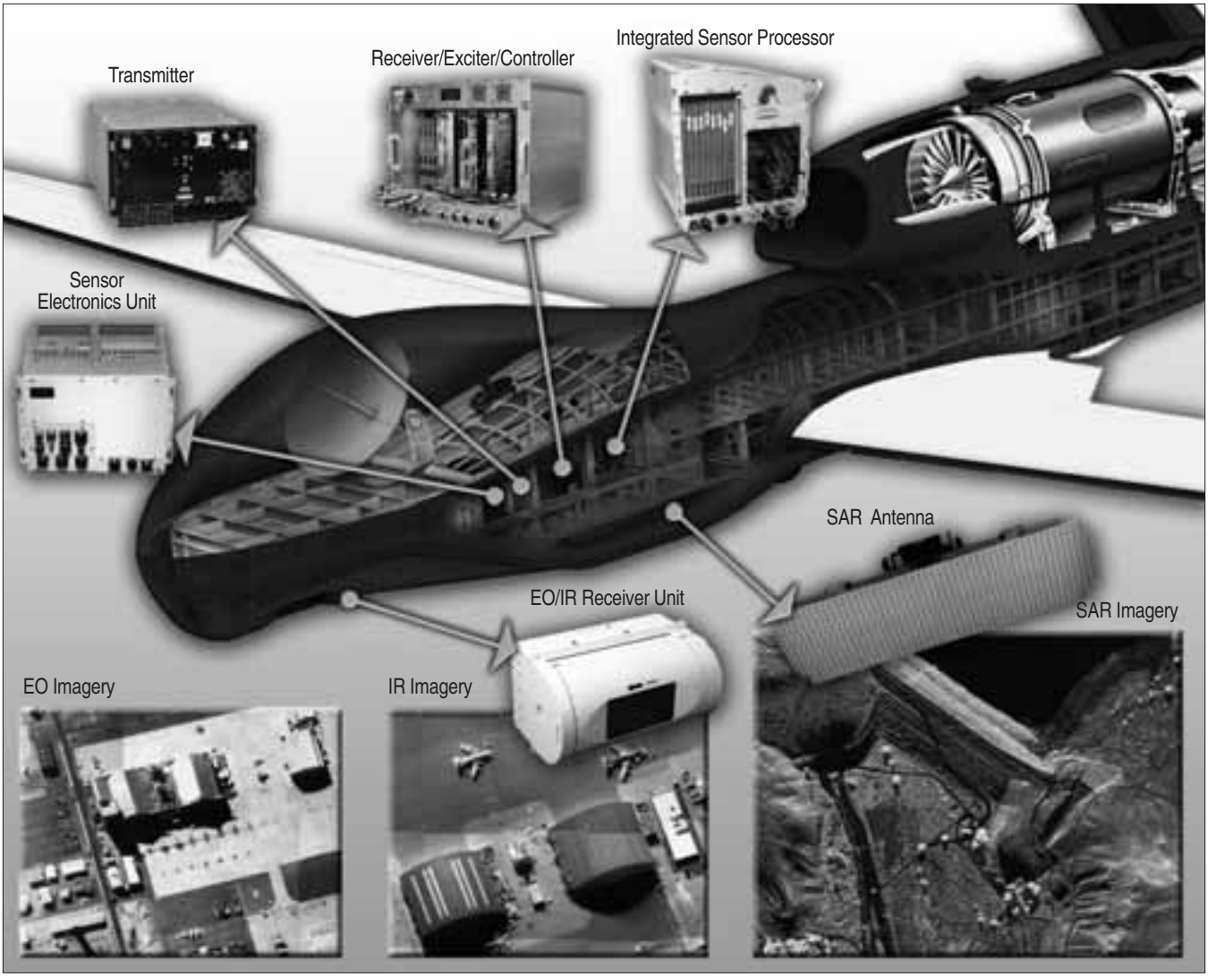


The Global Hawk acquisition strategy calls for a different approach to execute the important role of operational test. Programs like Global Hawk need to place greater reliance on "seamless verification," the term coined to describe the merging of developmental and operational test (DT and OT) requirements. We need to leverage each test event to accomplish both DT and OT objectives, while protecting the right of operational testers to report independently. These combined test activities could be supplemented with small, dedicated OT events as meaningful increments of technology are spiraled into production hardware. In the case of deployed systems like Global Hawk, these dedicated OT events should leverage deployed activity as much as possible. Why try to simulate the combat environment if we can assess the system in actual combat?

Finally, this revised OT concept must accommodate a build-up approach to the mature support concept. In a traditional program, the support concept is defined during the development phase. With simultaneous development and production, the support concept will mature as the system is fielded. As technology is spiraled into the production hardware, we must spiral the support concept and not wait until the desired end state to conduct operational testing.

Accelerate Logistics Planning

During the Global Hawk ACTD phase, neither DARPA nor the Air Force made significant investments in logistics planning. This corresponded with the ACTD philosophy of rapidly developing prototype hardware and putting it in the hands of operators to assess the system's military utility. Program investment was intentionally limited until the system's value had been assessed. This was a rea-



Cutaway of Global Hawk RQ-4 showing Integrated Sensor Suite locations. Graphic courtesy Northrop Grumman.

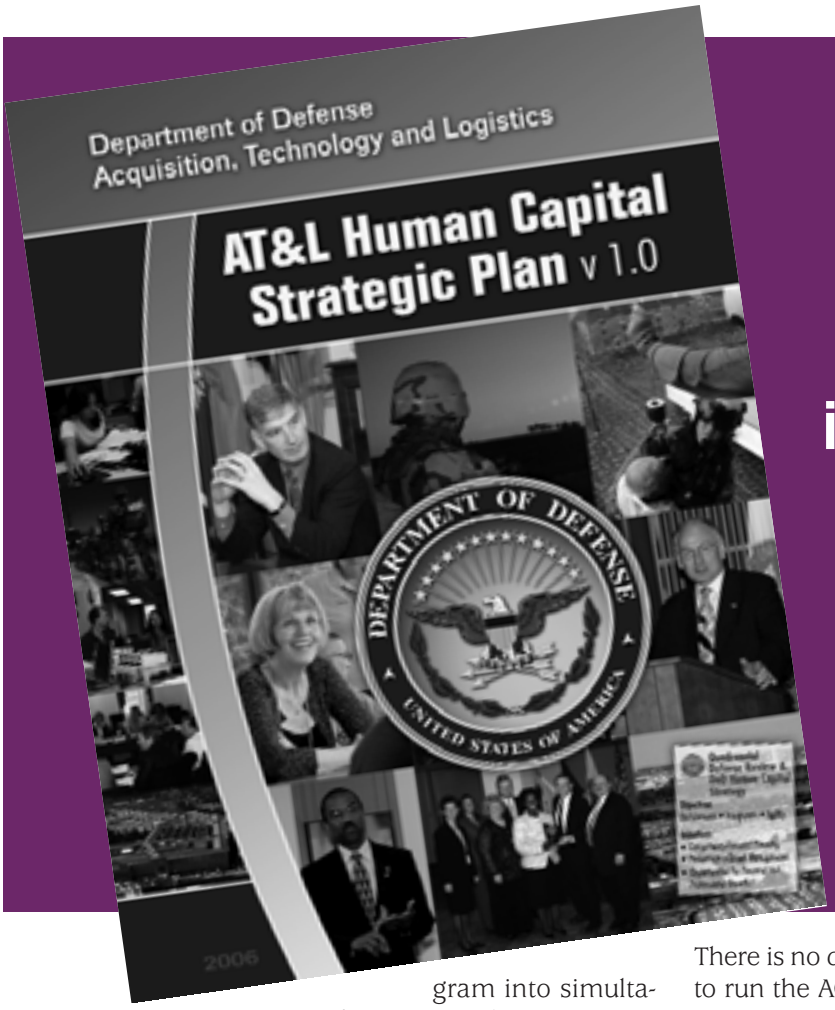
sonable approach but created logistics challenges when the program quickly transitioned into production.

In a more traditional acquisition strategy, logistics planning occurs during the EMD phase, typically in a logistics support analysis that provides the basis for making strategic logistics decisions, including defining requirements for spares, support equipment, training, and technical data. In the case of Global Hawk, we didn't have good information to make provisioning decisions when we negotiated the first production lots. Eventually the program invested in a limited logistics support analysis, but we're still catching up from this late start.

In retrospect, we should have started logistics planning much sooner. In fact, we missed a great opportunity to jump-start the process in 1999. When initial MUA results made it clear that DoD would be transitioning the ACTD into an acquisition program, the Air Force awarded a "pre-EMD" contract. This was a bridge contract to resolve limited technical issues while we completed the MUA and the milestone decision process. The pre-EMD contract would have been a useful mechanism to start logistics planning that would include defining support equipment requirements and using ACTD test data to populate a spares planning model. This approach would have provided a basis for defining early logistics strategies and applying them to the first production lot contracts.

Assess ACTD Contractor Ability to Execute Large Acquisition Program

DARPA awarded the original Global Hawk ACTD contract in 1995 to a contractor team led by Teledyne Ryan, who had a rich history with unmanned aerial vehicles dating back to the 1950s and a reputation as an excellent prototyping house. This reputation proved to be well-deserved, with Ryan leading the team to a successful first flight in just 2½ years and winning the prestigious Collier Trophy. [*Established in 1911, the Robert J. Collier Trophy is a national award honoring significant achievements in the advancement of aviation*.] The initial success convinced the Office of the Secretary of Defense to transition the pro-



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http://www.dau.mil/workforce/hcsp.pdf

gram into simultaneous EMD/LRIP. In just three years, annual funding increased from $80 million per year to more than $300 million. To accommodate this increased investment, prime contractor employment increased from 200 people to more than 800. The lead contractor also changed during this period when Northrop Grumman acquired Teledyne Ryan.

The program management tools and personnel skills sufficient to manage a smaller effort were not adequate to run a large ACAT ID program. One example is the lack of an overarching integrated master schedule (IMS) that linked all aspects of the program, including the different EMD spirals, production lots, and deployment activities. An ad hoc process of individual IMSs for distinct program elements was sufficient to execute the smaller ACTD program but was not adequate to identify bottlenecks in the more complex program. Two other important processes that were not sufficiently mature were the risk management process and the earned value management system. Northrop Grumman has now tapped expertise from across the corporation and put more robust processes in place, but the transition did not occur fast enough to prevent program perturbations. In fact, the program is currently completing a Nunn-McCurdy certification process for breaching program cost targets, in part because we did not have the proper tools in place early in the program.

There is no doubt Teledyne Ryan was an excellent choice to run the ACTD program. However, the Air Force faced a crossroad when transitioning the program into EMD/LRIP. We should have considered two options: first, re-competing the program to select a team better equipped to manage a larger effort; or second, working aggressively with the existing contractor team to put the proper tools and skills in place. In reality, we didn't execute either option. The Air Force awarded the follow-on contract to Northrop Grumman to keep the program moving forward, but we didn't adequately evaluate the contractor team's readiness to handle the larger program. At this point we have conducted a government-contractor assessment and corrected most of the identified tools/skills deficiencies. In retrospect we should have completed this step much earlier, as we were transitioning the program out of the ACTD phase.

Pursue More Measured Approach to Capability Improvements

In transitioning the program into EMD/LRIP, DoD's goal was to field an operationalized version of the ACTD hardware while using spiral development to add incremental capability enhancements. One of our major challenges was defining which enhancements were absolutely required to achieve an operationalized system, and which could be deferred for later delivery. Our extensive deployment and combat experience with ACTD hardware added fuel to the debate. To reflect many of the lessons

learned in combat, we modified existing contracts and incorporated enhancements into the first production hardware as it was being built. There has been a cost and schedule impact, but most of these capabilities are essential for mission accomplishment.

In some cases we should have deferred desired enhancements through a more measured development process. One example is a capability known as automatic contingency generation (ACG). In an in-flight emergency, ACG enables an air vehicle to autonomously determine the optimum flight path to divert to an alternative airfield while avoiding predetermined no-fly zones. The current approach is to rely on manual re-routing by the pilot during a mission. ACG would eliminate multiple steps in building a mission plan and shrink mission-planning cycle time below the requirement threshold. This requirement was documented after we negotiated early production lots, but we decided to add it to the first production baseline. In retrospect, we did not fully understand the complexity of ACG, and it quickly became the critical-path item in fielding the first production hardware. We have now deferred this capability to a future software release, but the time spent trying to field ACG in the first baseline delayed delivery of the first production hardware and training courses. While fielding production hardware in combat within five years of program start is noteworthy, we could have achieved this milestone even earlier had we tackled only those capability enhancements absolutely required for the first production baseline.

Accelerate Manufacturing Planning

In a traditional acquisition strategy, manufacturing planning and process development are important elements of EMD, representing the "M" in EMD. When we launched Global Hawk into simultaneous EMD/LRIP, we had done little production planning; we simply continued ACTD processes. This worked reasonably well for the first production lot, but we quickly ran into trouble on Lot 2. With the addition of Navy requirements for a maritime demonstration, the second lot grew to six air vehicles and multiple ground stations. This required a production rate the program was not ready to handle.

Global Hawk Electro-optical Imagery reveals suspected SA-2 launchers and missiles north of Baghdad.
U.S. Air Force imagery.

One pacing item became delivery of the primary air vehicle payload, the Integrated Sensor Suite (ISS) shown on page 9. During the ACTD phase, Raytheon built the ISS in a laboratory using a labor-intensive process. This approach was appropriate for the limited ACTD purchase but was not efficient for a longer production run. In the rapid transition to production, we allocated neither the time nor funding to plan for efficient production. This became painfully obvious as Raytheon struggled to apply ACTD processes and meet the steep ramp-up for Lot 2 ISS deliveries.

We have now recovered from this early challenge. In the case of the ISS, Raytheon has laid out a state-of-the-art, lean manufacturing process made possible by a $30 million Air Force investment in specialized test equipment (STE). Looking back, we needed to start manufacturing planning much earlier than we did. We could have used the pre-EMD contract described earlier to start planning an ACTD-to-LRIP production transition. In addition the Air Force should have included funding in the first production estimates for STE. In our rush to accelerate Global Hawk into production, we budgeted for hardware but didn't include estimates for STE needed to implement efficient production processes. We now know some amount of STE would have paid for itself with reduced production cost and was essential as we increased quantities.

Putting It Together

The rapid transition of Global Hawk from the ACTD phase into formal acquisition has achieved its primary objective: breaking the historical paradigm of lengthy acquisition cycle time. The Air Force deployed Global Hawk production hardware to Southwest Asia less than five years into the acquisition program, and the system is making a major contribution in CENTCOM combat operations. We did not have a template to follow in executing the nontraditional acquisition strategy that achieved this milestone, and we have encountered several challenges along the way. With careful planning and early commitment of resources, we believe programs that follow us can overcome these challenges and yield the same cycle time reduction achieved in the Global Hawk experience.

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